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Allowable Fish Tissue Calculations for PFCs (PFOA & PFOS) for Screening levels for the general population and high consumers

PFOA Non-Cancer Calculations

Basic equation:

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{RfD\times BW}{Consumption\ Rate}\right)$$

General Population - We typically use 2 meals/week (8 meals per month or 59.7 g/day) as our starting point for an advisory based on the American Heart Association's, EPA, and FDA recommendations to eat at least two fish meals per week.

Where:

RfD = DRAFT Reference Dose (RfD) for PFOA is 2.0 x 10^{-5} mg/kg-day based on Critical Effects increased liver weight, hepatic hypertrophy, increased kidney weight, reduced fetal ossification, accelerated puberty as outlined in on EPA's May 2016 Drinking Water Advisory for Perfluorooctanoic Acid (PFOA) assessment
BW = body weight (70 kg or 132 lbs)
Consumption rate = 59.7 gm/day (8-eight oz. meals per month)
gm/kg = conversion factor (1000 gm/kg)
Conc. $_{fish}$ = mean concentration of PFOA in fish (mg/kg)

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{2.0\ x\ 10^{-5}\ \frac{mg}{kg-day}\times 70\ kg\times 1000\frac{gm}{kg}}{59.7\ \frac{gm}{day}}\right)$$

Concentration in fish = 0.023 mg/kg or 23 ppb

High Consumer – Based on Ecology's proposed fish consumption rate used to establish Federal Clean Water Standards of 175 g/day (~23 meals per month) as our starting point for high consumers.

Where:

RfD = DRAFT Reference Dose (RfD) for PFOA is 2.0 x 10^{-5} mg/kg-day based on Critical Effects increased liver weight, hepatic hypertrophy, increased kidney weight, reduced fetal ossification, accelerated puberty as outlined in on EPA's May 2016 Drinking Water Advisory for Perfluorooctanoic Acid (PFOA) assessment
BW = body weight (70 kg or 154 lbs)
Consumption rate = 175 gm/day (~23-eight oz. meals per month)
gm/kg = conversion factor (1000 gm/kg)
Conc. $_{fish}$ = mean concentration of PFOA in fish (mg/kg)

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{2.0\ x\ 10^{-5}\ \frac{mg}{kg-day}\times 70\ kg\times 1000\ \frac{gm}{kg}}{175\ \frac{gm}{day}}\right)$$

Concentration in fish = 0.008 mg/kg or 8 ppb

PFOA Cancer Calculations
Findings: PFOA - Suggestive Evidence

Basic equation: $$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{RL\times BW}{CSF\times Consumption\ Rate}\right)$$

Where:

RL = Risk level set at one in one million ($1x10^{-6}$)
CSF = DRAFT Cancer Slope Factor (CSF) for PFOA is 0.07 mg/kg-day^{-1} based on evidence of testicular tumors as outlined in on EPA's May 2016 Drinking Water Advisory for Perfluorooctanoic Acid (PFOA) assessment
BW = body weight (70 kg or 154 lbs)
Consumption rate = 59.7 or 175 gm/day (8 or~23-eight oz. meals per month)
gm/kg = conversion factor (1000 gm/kg)
Conc. $_{fish}$ = mean concentration of PFOA in fish (mg/kg)

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{1.0\ x\ 10^{-6}\times 70\ kg\times 1000\frac{gm}{kg}}{0.07\left(\frac{mg}{kg-day}\right)^{-1}\times 59.7\ \frac{gm}{day}}\right)$$

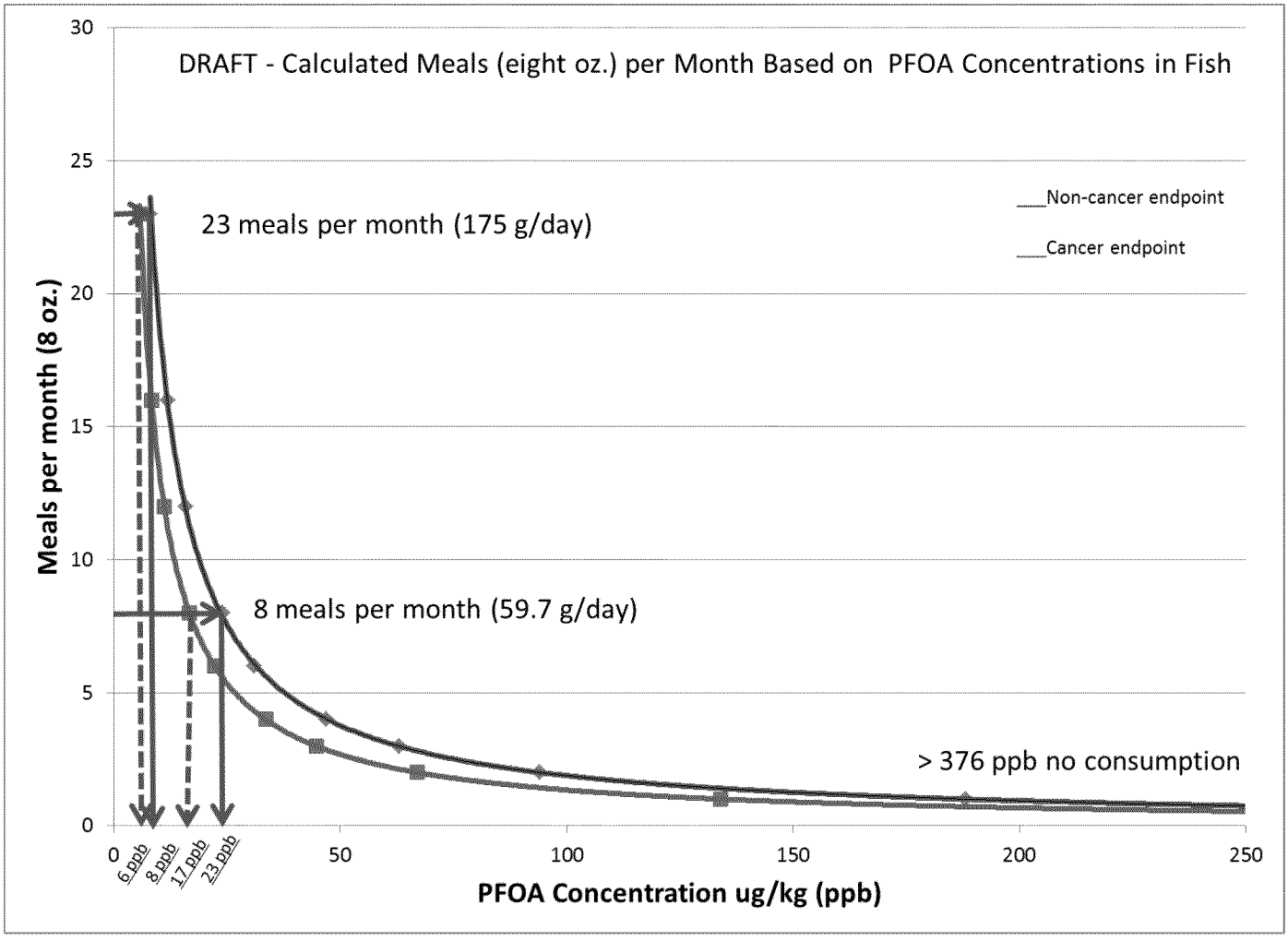
Concentration in fish based on 59.7 g/day = 0.017 mg/kg or 17 ppb

Concentration in fish based on 175 g/day = 0.006 mg/kg or 6 ppb

Cancer Risk at the RfD = Dose x CSF where the dose is set equal to the RfD, draft CSF = 0.07 mg/kg-day^{-1}

Cancer Risk = ($2x10^{-5}$mg/kg-day) x (0.07 mg/kg-day^{-1})
Cancer Risk = 1.4 x 10^{-6} or 1.4 in one million at the RfD

Therefore, using the non-cancer endpoint also results in a cancer risk of 1.4 in one million.


DRAFT - Calculated Meals (eight oz.) per Month Based on PFOA Concentrations in Fish
23 meals per month (175 g/day)
8 meals per month (59.7 g/day)
> 376 ppb no consumption
___Non-cancer endpoint
___Cancer endpoint
Meals per month (8 oz.)
PFOA Concentration ug/kg (ppb)
0
5
10
15
20
25
30
0
50
100
150
200
250
6 ppb
8 ppb
17 ppb
23 ppb

PFOS Non-cancer Calculation

Basic equation:

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{RfD\times BW}{Consumption\ Rate}\right)$$

General Population - We typically use 2 meals/week (8 meals per month or 59.7 g/day) as our starting point for an advisory based on the American Heart Association's, EPA, and FDA recommendations to eat at least two fish meals per week.

Where:

RfD = DRAFT Reference Dose (RfD) for PFOS is 2.0 x 10^{-5} mg/kg-day based on increased liver weight (10%), developmental neurotoxicity (increased motor activity and decreased habituation) as outlined in EPA's May 2016 Health Effects Support Document for Perfluorooctane Sulfonate (PFOS) assessment

BW = body weight (70 kg or 154 lbs)
Consumption rate = 59.7 gm/day (8-eight oz. meals per month)
gm/kg = conversion factor (1000 gm/kg)
Conc. $_{fish}$ = mean concentration of PFOS in fish (mg/kg)

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{2.0\ x\ 10^{-5}\ \frac{mg}{kg-day}\times 70\ kg\times 1000\frac{gm}{kg}}{59.7\ \frac{gm}{day}}\right)$$

Concentration in fish = 0.023 mg/kg or 23 ppb

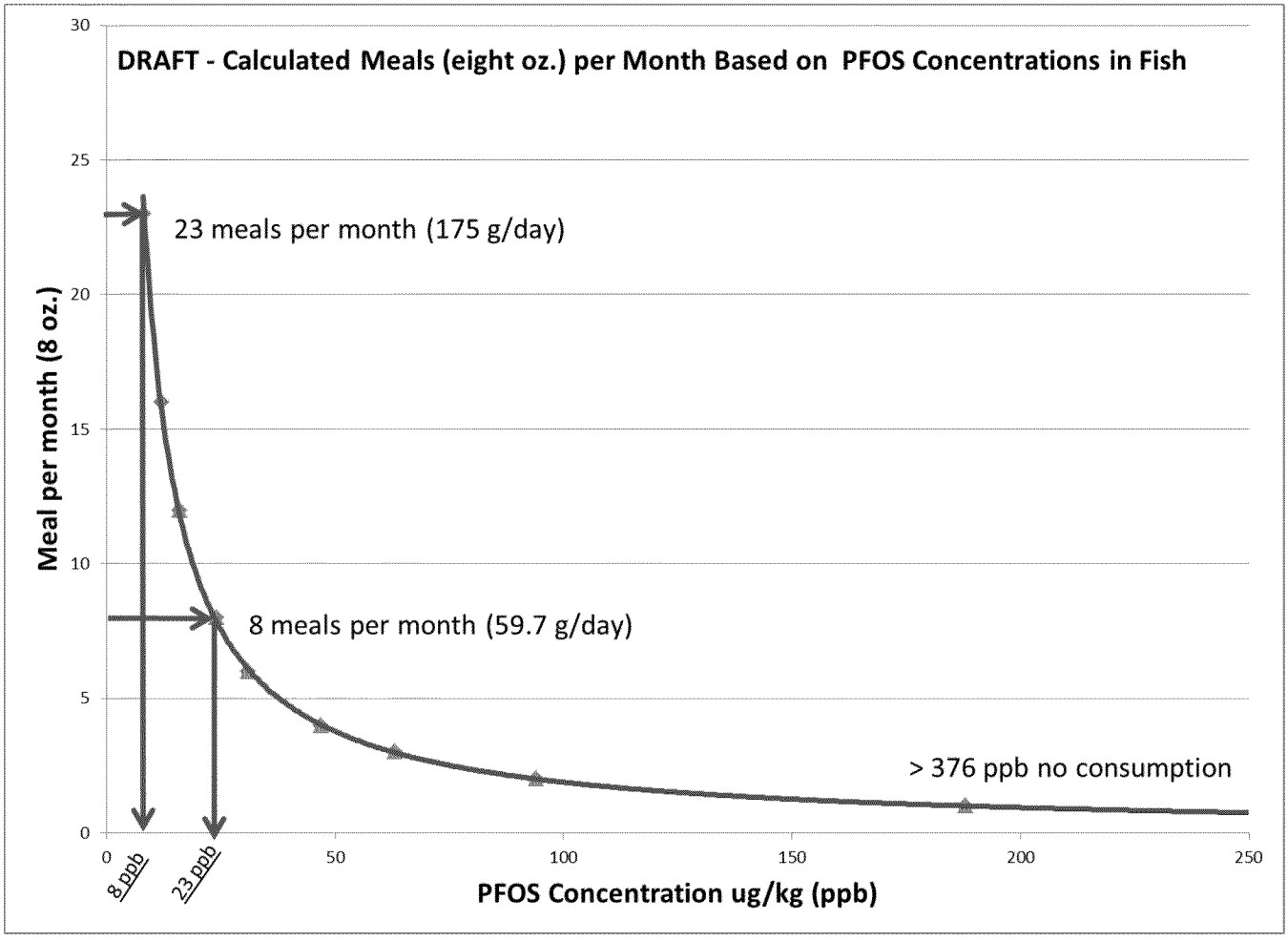
High Consumer – Based on Ecology's proposed fish consumption rate used to establish Federal Clean Water Standards of 175 g/day (~23 meals per month) as our starting point for high consumers.

Where:

RfD = DRAFT Reference Dose (RfD) for PFOS is 2.0 x 10^{-5} mg/kg-day based on increased liver weight developmental neurotoxicity (increased motor activity and decreased habituation) as outlined in EPA's May 2016 Health Effects Support Document for Perfluorooctane Sulfonate (PFOS) assessment
BW = body weight (70 kg or 154 lbs)
Consumption rate = 175 gm/day (~23-eight oz. meals per month)
gm/kg = conversion factor (1000 gm/kg)
Conc. $_{fish}$ = mean concentration of PFOS in fish (mg/kg)

$$Concentration\ in\ fish\left(\frac{mg}{kg}\right)=\left(\frac{2.0\ x\ 10^{-5}\ \frac{mg}{kg-day}\times 70\ kg\times 1000\ \frac{gm}{kg}}{175\ \frac{gm}{day}}\right)$$

Concentration in fish = 0.008 mg/kg or 8 ppb



Calculations do not include risk benefits, risk management, and risk communication decisions.

Meal Limit Calculations

Calculating Meal Limits for Individual Chemical Exposures

When estimated exposures for any given population exceed comparison values considered to be protective (i.e. RfDs or acceptable cancer risks), meal limits are calculated to inform any advice that might be provided to consumers. DOH calculates allowable meal limits based on EPA's RfD, ATSDR's Minimal Risk Level (MRL), or EPA's CSF, the average body weight of an individual, and the known contaminant concentration in seafood. These calculations allow DOH to formulate advice that will be useful to consumers.

By using the known concentration of a contaminant in a seafood species, it is possible to calculate a meal limit for that species that will result in a dose equivalent to the RfD for that contaminant. In this approach, the RfD is used to calculate the quantity of seafood a

person of a given body weight can safely consume given varying contaminant concentrations found in seafood tissue. The equation used to calculate a safe consumption rate is shown below, with exposure parameters as defined below:

Non-cancer meal equation:

Where: **BW** = body weight (70 kg or 154 lbs)
CF = Conversion Factor (30.44 days/month)
MS = Meal Size (0.227 kg/meal)
RfD = DRAFT EPA derived chemical specific oral Reference Dose (mg/kg-day)
C = Chemical concentration of PFOA or PFOS in fish tissue (mg/kg)

Calculating Non-Cancer Meal Limits Based on Combination of PFOA and PFOS Exposures

In addition to individual contaminant effects calculated above, consideration for potential additive non-cancer health effects of the combination of PFOS and PFOA exposure can also be calculated. Because these PFCs can have similar toxic endpoints (neurological and developmental health endpoints), the preceding equation can be adapted to calculate meal limits that account for additive effects. The adapted equation is shown, below:

Where: **BW** = body weight (70 kg or 154 lbs)
CF = Conversion Factor (30.44 days/month)
MS = Meal Size (0.227 kg/meal)
RfD = DRAFT EPA derived chemical specific oral Reference Dose (mg/kg-day)
C = Chemical concentration of PFOA and PFOS in fish tissue (mg/kg)

Given that the RfD for both PFOA and PFOS are identical, a simpler approach would be to simply add up the PFOA and PFOS and use the resulting combined concentration in the PFOA or PFOS equation.